RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WATER RESOURCES

APPENDIX B

RIDEM AMBIENT WATER QUALITY

CRITERIA AND GUIDELINES FOR TOXIC POLLUTANTS

AUGUST 6, 1997

WATER QUALITY REGULATIONS
APPENDIX B

I. General

Section 304(a)(1) of the Federal Clean Water Act (CWA) requires the USEPA to develop and publish water quality criteria. The USEPA has published criteria for a number of the pollutants listed pursuant to Section 307(a)(1) of the CWA, as well as for other toxic substances, based on available toxicological information on the pollutants. Section 303(c)(2)(B) of the CWA, as amended by the Water Quality Act of 1987, requires states to adopt numeric criteria to protect the uses of their waters from all toxic pollutants listed pursuant to Section 307(a)(1) for which criteria have been published pursuant to Section 304(a)(1), and which are present, or could reasonably be expected to be present, at levels that would impair the uses. This Appendix contains the ambient chemical-specific numeric criteria and guidelines for aquatic life and human health which satisfies the requirements of Section 303(c)(2)(B).

Table 1 contains the acute and chronic aquatic life criteria and minimum data base guidelines for freshwater and saltwater and two sets of human health criteria. In Table 1, the first column of human health criteria represents criteria applicable to waters designated as public drinking water supplies, where the potential for water and fish consumption exists. The second column under human health represents criteria applicable to all other waters, where the designated route of exposure is due only to fish consumption.

For parameters which have both aquatic life and human health criteria or guidelines, the applicable criteria or guideline is determined by using the more stringent of the aquatic life or human health criteria or guidelines, according to the use of the waterbody.

Aquatic life criteria may be subject to site-specific modification procedures, as referenced in rules 8.D.(2) and 8.D.(3) of these Regulations, in accordance with RIDEM's most current "Site-Specific Aquatic Life Water Quality Criteria Development Policy" and EPA's "Determination and Use of WERs for Metals, EPA-823-B-94-001,February 1994. Aquatic life guidelines may be modified by adding to the database following the procedures outlined on page B-4 of this Appendix. Human health criteria are subject to site-specific criteria development utilizing the methodology in the EPA guidance manual, "Assessing Human Health Risk from Chemically-Contaminated Fish and Shellfish" (EPA - 503/8-89-002), and the methodology published in the Federal Register on November 28, 1980 (45 FR 79347) entitled "Water Quality Criteria Documents; Availability, Appendix C - Guidelines and Methodology used in Preparation of Health Effect Assessment Chapters of the Consent Decree Water Criteria Documents", or the most recent EPA documentation.

In addition to these criteria and guidelines, Table 5 of this Appendix contains a complete list of "priority pollutants."

II. Aquatic Life Criteria

The aquatic life criteria in Table 1 represents the EPA water quality criteria for the protection of aquatic life, pursuant to Section 304(a) of the CWA, for acute and chronic exposure to toxics in freshwater and saltwater. These toxics are priority metals, organics, pesticides, PCBs and cyanide. To protect aquatic life, the one hour average concentration of a pollutant should not exceed the acute criteria more than once every three years on the average. An exclusion to this rule are the pesticides and PCBs acute criteria which are considered instantaneous values (See footnote $ to Table 1). The four day average concentration of a pollutant should not exceed the chronic criteria more than once every three years on the average. These aquatic life criteria shall be achieved in all waters, except mixing zones, regardless of the waters' classification.

The acute and chronic aquatic life criteria for freshwaters shall not be exceeded at or above the lowest average

7 consecutive day low flow with an average recurrence frequency of once in 10 years (7Q10). For non-flowing freshwaters, the acute and chronic aquatic life criteria shall not be exceed under the most adverse conditions which will be determined on a case-by case basis.

The acute and chronic aquatic life criteria for seawater shall not be exceeded beyond the boundary of the mixing zone(s), as defined and determined by rules 8.D.(1).e. and 8.D.(1).f. of the Water Quality Regulations, and thence throughout the waterbody. If a mixing zone has not been established, these criteria shall not be exceeded in any portion of the receiving water.

For purposes of calculating freshwater aquatic life criteria for metals from the equations in Table 2, the minimum hardness allowed for use in those equations shall be 25 mg/l, as calcium carbonate, even if the actual ambient hardness is less than 25 mg/l as calcium carbonate. The hardness values used shall be consistent with the design flow conditions established in rules 8.D. and 8.E. of the Regulations. For waters in which the salinity is equal to or less than one part per thousand, the applicable criteria are the freshwater criteria. For waters in which the salinity is equal to or greater than ten parts per thousand, the applicable criteria are the saltwater criteria. For waters in which the salinity is between one and ten parts per thousand, the applicable criteria are the more stringent of the freshwater or saltwater criteria. However, for those waters between one and ten parts per thousand, the Department may deviate from the general rule if scientifically defensible information and data demonstrates that on a site-specific basis the biology of the waterbody is dominated by freshwater aquatic life and that freshwater criteria are more appropriate; or conversely, the biology of the waterbody is dominated by saltwater aquatic life and that saltwater criteria are more appropriate.

The acute and chronic freshwater criteria for 10 metals and the acute and chronic saltwater criteria for 11 metals listed in Table 1 are presented as dissolved metal criteria (see footnotes #5 and #6 on Table 1). For these metals, the dissolved metal, as opposed to the total recoverable metal, more closely approximates the bioavailable fraction of the metal in the water column. The conversion factors (CF) to calculate dissolved metal from total metal concentrations as listed in footnotes #5 and #6 are based on current EPA guidance (Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria, October 1, 1993; "Derivation of Correction Factors for the Calculation of Dissolved Freshwater Aquatic Life Criteria for Metals", Stephan, USEPA, March 31, 1995; "Derivation of Conversion Factors for the Calculation of Dissolved Saltwater Aquatic Life Criteria for Metals", USEPA, March 31, 1995; Federal Register, Vol. 60, No. 68, Thursday May 4, 1995, p. 22228-22237) and are subject to change as more data becomes available. The following formulas are used for calculating dissolved metals criteria:

$$\text{Acute Criteria}_{\text{dissolved}} = \text{Acute Criteria}_{\text{total recoverable}} \times \text{Acute Conversion Factor}$$

$$\text{Chronic Criteria}_{\text{dissolved}} = \text{Chronic Criteria}_{\text{total recoverable}} \times \text{Chronic Conversion Factor}$$

It should be noted that the chronic saltwater and chronic freshwater criteria for mercury are presented as total recoverable because the mercury criteria is based on mercury residues in aquatic organisms rather than toxicity. The saltwater criteria for Copper are based on new data outlined in current EPA guidance ("Ambient Water Quality Criteria - Copper, Addendum EPA 1995"; and Federal Register, Vol. 60, No. 68, Thursday, May 4, 1995, p. 22228-22237.

III. Site Specific Criteria

Section 131.11(b)(1)(ii) of the Federal water quality standards regulation provides States with the opportunity to adopt water quality criteria that are modified to reflect local environmental conditions. Following the procedures outlined in RIDEM's "Site Specific Aquatic Life Water Quality Criteria Development Policy", as amended, and EPA's "Interim Guidance on Determination and Use of Water-Effect Ratios for Metals", (February 1994, EPA-823-B-94-001), acute Water Effect Ratios (WERs) were developed for 5 metals; cadmium, copper, lead, silver and zinc (Table 4). The WER procedure provides for the use of a WER that is intended to take into account relevant differences between the toxicities of the chemical in laboratory dilution water and in site water. These WERs are then used to derive acute site specific criteria from the State aquatic life criteria as indicated in Table 4. Chronic site specific criteria are then calculated using the derived acute site specific criteria, as indicated in Table 4. The "RI Site Specific Criteria Development Policy" and the WER procedures were applied using total recoverable metals and therefore, the calculated site specific criteria are in the form of total recoverable metals. The conversion factors for converting total recoverable metal criteria to dissolved metal criteria cannot be applied to these site specific criteria.

The criteria derived from these WERs (Table 4), and therefore not the criteria listed in Tables 1 and 2, apply to the segments of the Pawtuxet River classified as B1 (see Appendix A).

IV. Freshwater Minimum Data Base Guidelines

RIDEM has derived freshwater guidelines for many pollutants for which EPA water quality criteria are not available. In order for guidelines to be derived, the toxicity data base for the pollutants must meet minimum requirements. These guidelines are given in Table 1 and are marked with an asterisk (*).

The data base must contain at least two acute toxicity test results expressed as either an EC_{50} or an LC_{50} as specified in the EPA Water Quality Criteria Guidelines (45 FR 79343, 1980 and amendments). "LC_{50}" is defined as the concentration of a test material in a suitable diluent at which 50 percent of the exposed organisms die during a specified time period. "EC_{50}" is defined as the concentration of a test material in a suitable diluent at which 50 percent of the exposed organisms exhibit a specified response during a specified time period.
The two acute toxicity test results shall consist of:

1. One daphnid (D. magna or D. pulex)

2. One fish, either:

    (a) fathead minnow (Pimephales promelas)

    (b) bluegill (Lepomis macrochirus)

    (c) rainbow trout (Salmo gairdneri)

For every pollutant which meets these minimum data requirements, acute and chronic guidelines are derived using the following equations:

Lowest LC_{50} or EC_{50} x 0.05 = Acute Guideline

Acute Guideline ÷ 45 = Chronic Guideline

The uncertainty factor, 0.05, is intended to provide an adequate margin of safety to protect most aquatic organisms from acutely toxic effects. The uncertainty factor was selected by calculating uncertainty factor guidelines for those pollutants with EPA Water Quality Criteria. These guidelines were most similar to the EPA Water Quality Criteria when an uncertainty factor of 0.05 was used.

The acute guideline is divided by an acute to chronic ratio of 45 to yield the chronic guideline. This ratio was derived by the State of Michigan using all available acute to chronic values for priority pollutant tests performed on freshwater species. It was determined that 80% of the pollutants would have a geometric mean acute to chronic ratio of 45 or less.

V. Human Health Criteria

The human health criteria in Table 1 represent the EPA water quality criteria which would not result in a significant risk to public health. For almost all of the pollutants, bioaccumulation properties are used to assess the relative extent of human exposure to the pollutant either directly through ingestion or indirectly through consumption of aquatic organisms. As research continues on reference dose factors and cancer potency factors, new or updated human health criteria may be established by EPA and utilized by RIDEM. These new or updated human health criteria are maintained in EPA's electronic database known as Integrated Risk Information System (IRIS).

Ambient water quality criteria for human health are primarily based on two types of biological endpoints: (1) carcinogenicity and; (2) toxicity (i.e., all other adverse effects other than cancer). There are essentially two procedures for assessing health effects; one which addresses carcinogens and one which addresses non-carcinogens. The reason for having two methodologies is that, for the purpose of deriving ambient water quality criteria, carcinogenicity is regarded as a non-threshold phenomenon, whereas toxicity is regarded as having a threshold below which there will not be an effect. For those toxic substances which are identified as carcinogens, the criteria have been established at a risk level of 10^{-5} assuming a lifetime exposure to a 70 kg male consuming 6.5 grams per day of fish and shellfish product and ingesting 2.0 liters of water per day. For those toxic substances which are identified as non-carcinogens, the human health criteria are best estimates of concentrations which are not expected to produce adverse effects in human health assuming a lifetime exposure of a 70 kg male consuming 6.5 grams per day of fish and shellfish products and ingesting 2.0 liters of water per day.

These criteria represent the chronic criteria necessary to protect human health. Non-carcinogen human health criteria are developed assuming that effects occur after days or weeks of exposure. It is assumed that, up to a certain point, the body's natural defense mechanisms can adequately protect the exposed organ(s). Therefore, the design flow to be utilized for freshwater non-carcinogen criteria is the lowest average thirty consecutive day low flow with an average recurrence frequency of once in five years (30Q5). Freshwater carcinogenic criteria are developed assuming exposure over a lifetime (70 years). The design flow to be used with these criteria is the harmonic mean flow which is a long term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows. For non-flowing freshwaters, the human health criteria shall not be exceed under the most adverse conditions which will be determined on a case-by case basis. For seawaters, the ambient human health water quality criteria for carcinogens and non-carcinogens are applicable when the most adverse hydrographic and pollution conditions occur at the particular point of evaluation.

VI. Priority Pollutants Without Criteria or Guidelines

Any pollutant listed on the most recent EPA priority pollutant list published in accordance with Section 307(a)(1) of the Clean Water Act (Table 5 of this Appendix) or additional criteria EPA has established for non-priority pollutants, for which there is no RIDEM ambient water quality criteria or guideline, shall be regulated in accordance with rules 8.D.(2) and 8.D.(3) of the Regulations.

Table 1. RIDEM Ambient Water Quality Criteria and Guidelines

CHEMICAL NAME	AQUATIC LIFE CRITERIA (μg/l) FRESHWATER ACUTE	FRESHWATER CHRONIC	SALTWATER ACUTE	SALTWATER CHRONIC	CARCINOGEN ?	HUMAN HEALTH CRITERIA [1] (μg/l)[2] Class A waters - Consumption	All other waters- Fish Water & Fish Consumption Only
ACENAPHTHENE	* 85	* 1.9	-	-	no	1200	2700
ACROLEIN	* 2.9	* 0.06	-	-	no	320	780
ACRYLONITRILE	* 378	* 8.4	-	-	yes	0.59	6.6
ALDRIN	$ 3.0	-	$ 1.3	-	yes	1.3 ng/l	1.4 ng/l
ALUMINUM	750■	87■	-	-		-	-
AMMONIA	#	#	#	#	no	-	-
ANTIMONY	* 450	* 10	-	-	no	14	4300
ARSENIC [5,6]	360	190	69	36	yes	50	50
ASBESTOS	-	-	-	-	yes	$7x10^6$ fibers/l	
BENZENE	* 265	* 5.9	-	-	yes	12	710
BENZIDINE	-	-	-	-	yes	1.2 ng/l	5.4 ng/l
BERYLLIUM	* 7.5	* 0.17	-	-	yes	-	-
CADMIUM [5,6]	@	@	42	9.3	no	-	-
CARBON TETRACHLORIDE	* 1365	* 30	-	-	yes	2.5	44
CHLORDANE	$ 2.4	0.0043	$ 0.09	0.004	yes	5.7 ng/l	5.9 ng/l
CHLORINE	19	11	13	7.5			
CHLORINATED BENZENES							
CHLOROBENZENE	* 795	* 18	-	-	no	680	21 mg/l

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HEXACHLOROBENZENE	-	-	-	-	yes	7.5 ng/l	7.7 ng/l
1,2,4-trichlorobenzene	* 75	* 1.7	-	-		-	-
1,2,3,5-tetrachlorobenzene	* 321	* 7.1	-	-		-	-
pentachlorobenzene	* 13	* 0.28	-	-		-	-
CHLORINATED ETHANES							
1,2-DICHLOROETHANE	* 5900	* 131	-	-	yes	3.8	990
1,1,1-TRICHLOROETHANE	-	-	-	-	no	-	-
1,1,2-TRICHLOROETHANE	* 900	* 20	-	-	yes	6.0	420
HEXACHLOROETHANE	* 49	* 1.1	-	-	yes	19	89
1,1,2,2-TETRACHLOROETHANE	* 466	* 10	-	-	yes	1.7	110
1,1,1,2-TETRACHLOROETHANE	* 980	* 22	-	-		-	-
PENTACHLOROETHANE	* 362	* 8.0	-	-		-	-
CHLORINATED PHENOLS							
2,4,6-TRICHLOROPHENOL	* 16	* 0.36	-	-	yes	21	65
2-CHLOROPHENOL	-	-	-	-	no	120	400
4-CHLOROPHENOL	* 192	* 4.3	-	-		-	-
2,4,5-TRICHLOROPHENOL	* 23	* 0.51	-	-		-	-
2,3,4,6-TETRACHLOROPHENOL	* 7	* 0.16	-	-		-	-

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2,3,5,6-TETRACHLOROPHENOL	* 8.5	* 0.19	-	-		-	-
4-CHLORO-2-METHYLPHENOL	* 15	* 0.32	-	-		-	-
2,4-DICHLORO-6-METHYLPHENOL	* 22	* 0.48	-	-		-	-
CHLOROALKYL ETHERS							
BIS(2-CHLOROETHYL)ETHER	-	-	-	-	yes	0.31	14
BIS(2-CHLOROISOPROPYL)ETHER	-	-	-	-	no	1400	170 mg/l
CHLOROFORM	* 1445	* 32	-	-	yes	57	4700
1-CHLORONAPHTHALENE	* 80	* 1.8	-	-		-	-
2-CHLORONAPHTHALENE	-	-	-	-	no	1700	4800
2-CHLOROPHENOL	* 129	* 2.9	-	-	no	-	-
CHROMIUM III [5]	@	@	-	-	no	-	-
CHROMIUM VI [5,6]	15	10	1100	50	no	-	-
COPPER [5,6]	@	@	4.8	3.1	no	1300	-
CYANIDE	22	5.2	1.0	1.0	no	700	220 mg/l
4,4-DDT	$ 1.1	0.001	$ 0.13	0.001	yes	5.9 ng/l	5.9 ng/l
4,4-DDE	-	-	-	-	yes	5.9 ng/l	5.9 ng/l
4,4-DDD	-	-	-	-	yes	8.3 ng/l	8.4 ng/l
DICHLOROBENZENES							
1,2-DICHLOROBENZENE	* 79	* 1.8	-	-	no	2700	17 mg/l

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1,3-DICHLOROBENZENE	* 390	* 8.7	-	-	no	400	2600
1,4-DICHLOROBENZENE	* 56	* 1.2	-	-	no	400	2600
DICHLOROBENZIDINES							
3,3-DICHLOROBENZIDENE	-	-	-	-	yes	0.40	0.77
DICHLOROETHYLENES							
1,1-DICHLOROETHYLENE	* 580	* 13	-	-	yes	0.57	32
2,4-DICHLOROPHENOL	* 101	* 2.2	-	-	no	93	790
1,3-DICHLOROPROPYLENE	-	-	-	-	no	10	1700
DIELDRIN	$ 2.5	0.0019	$ 0.71	0.0019	yes	1.4 ng/l	1.4 ng/l
1,2-TRANS-DICHLOROETHYLENE	-	-	-	-	no	700	-
2,4-DIMETHYLPHENOL	* 106	* 2.4	-	-	no	540	2300
DICHLOROPROPANES							
1,1-DICHLOROPROPANE	* 1150	* 26	-	-		-	-
1,2-DICHLOROPROPANE	* 2625	* 58	-	-	yes	5.2	390
1,3-DICHLOROPROPANE	* 303	* 6.7	-	-		-	-
DINITROTOLUENES							
2,4-DINITROTOLUENE	* 1550	* 34	-	-	yes	1.1	91
2,3-DINITROTOLUENE	* 17	* 0.37	-	-		-	-

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2,3,7,8-TCDD (Dioxin)	-	-	-	-	yes	0.00000013	0.00000014
1,2-DIPHENYLHYDRAZINE	* 14	* 0.31	-	-	yes	0.40	5.4
ENDOSULFAN (alpha, beta)	$ 0.22	0.056	$ 0.034	0.0087	no	0.93	2.0
ENDOSULFAN (sulfate)	-	-	-	-	no	0.93	2.0
ENDRIN	$ 0.18	0.0023	$ 0.037	0.0023	no	0.76	0.81
ENDRIN ALDEHYDE	-	-	-	-	no	0.76	0.81
ETHYLBENZENE	* 1600	* 36	-	-	no	3100	29 mg/l
FLUORANTHENE	* 199	* 4.4	-	-	no	300	370
HALOMETHANES							
BROMOFORM	* 1465	* 33	-	-	yes	43	3600
BROMOMETHANE (methyl bromide)	-	-	-	-	no	48	4000
CHLORODIBROMOMETHANE	-	-	-	-	yes	4.1	340
CHLOROMETHANE (methyl chloride)	-	-	-	-	yes	-	-
METHYLENE CHLORIDE	* 9650	* 214	-	-	yes	47	16 mg/l
DICHLOROBROMOMETHANE	-	-	-	-	yes	2.7	220
4-BROMOPHENYL PHENYL ETHER	* 18	* 0.4	-	-		-	-
HEPTACHLOR	$ 0.52	0.0038	$ 0.053	0.0036	yes	2.1 ng/l	2.1 ng/l
HEPTACHLOR EPOXIDE	$ 0.52	0.0038	$ 0.053	0.0036	yes	1.0 ng/l	1.1 ng/l
HEXACHLOROBUTADIENE	-	-	-	-	yes	4.4	500

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HEXACHLOROCYCLOPENTADIENE	*0.35	*0.008	-	-	no	240	17000
HEXACHLOROCYCLOHEXANE							
Alpha BHC	-	-	-	-	yes	39 ng/l	130 ng/l
Beta BHC	-	-	-	-	yes	140 ng/l	460 ng/l
Gamma BHC (Lindane)	$2	0.08	$0.16	-	yes	190 ng/l	630 ng/l
ISOPHORONE	*5850	*130	-	-	yes	84	6000
LEAD [5,6]	@	@	210	8.1	no	-	-
MERCURY [5,6]	2.1	0.0122	1.8	0.025	no	0.14	0.15
NICKEL [5,6]	@	@	74	8.2	no	610	4600
NAPHTHALENE	*115	*2.6	-	-		-	-
NITROBENZENE	*1350	*30	-	-	no	17	1900
NITROPHENOLS							
2,4-DINITROPHENOL	*31	*0.69	-	-	no	70	14 mg/l
4,6-DINITRO-2-METHYL PHENOL (4,6-dinitro-o-cresol)	-	-	-	-	no	13.4	765
4-NITROPHENOL	-	-	-	-		-	-
2,4,6-TRINITROPHENOL	4235	94	-	-		-	-
2,4-DINITRO-6-METHYL PHENOL	12	0.26	-	-		-	-
NITROSAMINES							
N-NITROSODI-N-PROPYLAMINE	-	-	-	-	yes	0.05	14.0
N-NITROSODIMETHYLAMINE	-	-	-	-	yes	6.9 ng/l	81

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N-NITROSODIPHENYLAMINE	* 293	* 6.5	-	-	yes	50	160
PENTACHLOROPHENOL	@	@	13	7.9	yes	2.8	82
PHENOL	* 251	* 5.6	-	-	no	21 mg/l	4600mg/l
PHTHALATE ESTERS							
BUTYL BENZYL PHTHALATE	* 85	* 1.9			no	3000	5200
BIS(2-ETHYLHEXYL)PHTHALATE	* 555	* 12	-	-	yes	18 mg/l	59 mg/l
DI-n-BUTYL PHTHALATE	-	-	-	-	no	2700	12 mg/l
DIETHYL PHTHALATE	* 2605	* 58	-	-	no	23 mg/l	120 mg/l
DIMETHYL PHTHALATE	* 1650	* 37	-	-	no	313 mg/l	2.9 g/l
POLYCHLORINATED BIPHENYLS[3]	-	0.014	-	0.03	yes	0.44 ng/l	0.44 ng/l
POLYCYCLIC AROMATIC HYDROCARBONS[4]	-	-	-	-	yes	0.028	0.31
ANTHRACENE	-	-	-	-	no	9600	110 mg/l
FLUORENE	-	-	-	-	no	1300	14000
PYRENE	-	-	-	-	no	960	11 mg/l
SELENIUM [6]	20	5	290	71	no	-	-
SILVER [5,6]	@	-	1.9	-	no	-	-
TETRACHLOROETHYLENE	* 240	* 5.3	-	-	yes	8.0	88.5
THALLIUM	* 46	* 1.0	-	-	no	1.7	6.3
TOLUENE	* 635	* 14	-	-	no	6800	200 mg/l

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TOXAPHENE	0.73	0.0002	0.21	0.0002	yes	7.3 ng/l	7.5 ng/l
TRICHLOROETHYLENE	* 1950	* 43	-	-	yes	27	810
VINYL CHLORIDE	-	-	-	-	yes	20	5250
ZINC [5,6]	@	@	90	81	no	-	-

KEY:

* = RIDEM minimum database guidelines

@ = see Table 2 for criteria equations

■ = freshwater criteria for aluminum are for waters in which the pH is between 6.5 and 9.

[1] = carcinogens calculated at 10^{-5} risk

[2] = criteria are in μg/l unless otherwise noted
μg/l = micrograms/liter
ng/l = nanograms/liter
mg/l = milligrams/liter

[3] = Polychlorinated Biphenyls criteria apply to each of the following:
PCB 1016 PCB 1248 PCB 1242 PCB 1232
PCB 1254 PCB 1260 PCB 1221

= see Table 3 for ammonia criteria

- = no criteria recommendation

$ = The aquatic life criteria for these compounds were issued in 1980 utilizing the 1980 Guidelines for criteria development. The acute values shown are final acute values which by the 1980 Guidelines are instantaneous values as contrasted with a Criteria Maximum Concentration (CMC) which is a one-hour average.

[4] = Polycyclic Aromatic Hydrocarbons criteria apply to each of the following:
indeno(1,2,3-cd)pyrene
dibenzo(ah)anthracene
benzo(a)anthracene
benzo(a) pyrene
benzo(b)fluoranthene
benzo(k)fluoranthene
chrysene

(Key is continued on next page)

Table 1. RIDEM Ambient Water Quality Criteria and Guidelines

[5] = Freshwater values in Table 1 for the following parameters represent dissolved criteria using the EPA recommended conversion factors (CF), as listed below:

Metal	Acute CF	Chronic CF
Arsenic	1.000	1.000
Cadmium	1.136672 - [(ln H) x 0.041838]	1.101672 - [(ln H) x 0.041838]
Chromium III	0.316	0.86
Chromium VI	0.982	0.962
Copper	0.96	0.96
Lead	1.46203 - [(ln H) x 0.145712]	1.46203 - [(ln H) x 0.145712]
Mercury	0.85	N/A (see Note below)
Nickel	0.998	0.997
Silver	0.85	(no freshwater criteria)
Zinc	0.978	0.986

NOTE: (ln H) = natural log of Hardness, using any hardness as appropriate.
N/A = chronic criteria for mercury cannot be converted to dissolved because it is based on mercury residues in aquatic organisms rather than toxicity.

[6] = Saltwater values in Table 1 for the following parameters represent dissolved criteria using the EPA recommended conversion factors, as listed below:

Metal	Conversion Factor
Arsenic	1.000
Cadmium	0.994
Chromium III	(no saltwater criteria)
Chromium VI	0.993
Copper	0.83
Lead	0.951
Mercury	0.85 (see Note below)
Nickel	0.990
Selenium	0.998
Silver	0.85
Zinc	0.946

NOTE: Conversion factors on this table were calculated for acute criteria only. Conversion factors for chronic criteria are not currently available. In the absence of chronic conversion factors saltwater acute conversion factors are used. Chronic criteria for mercury cannot

be converted to dissolved because it is based on mercury residues rather than toxicity.

Table 2. Freshwater Criteria Equations and Base e Exponential Values

Parameter	**ACUTE** (μg/l) $CF \times e^{(m_a [\ln Hardness] + b_a)}$			**CHRONIC** (μg/l) $CF \times e^{(m_c [\ln Hardness] + b_c)}$		
	CF =	m_a =	b_a =	CF =	m_c =	b_c =
Cadmium	@	1.128	-3.828	@	0.7852	-3.49
Chromium III	0.316	0.8190	3.688	0.86	0.819	1.561
Copper	0.96	0.9422	-1.464	0.96	0.8545	-1.465
Lead	#	1.273	-1.46	#	1.273	-4.705
Nickel	0.998	0.846	3.3612	0.997	0.846	1.1645
Silver	0.85	1.72	-6.52	-	-	-
Zinc	0.978	0.8473	0.8604	0.986	0.8473	0.7614
Pentachlorophenol*	-	1.005	-4.83	-	1.005	-5.29

- Hardness values are in mg/l as $CaCO_3$
- Lowest Hardness to be used with these equations is **25 mg/l** as $CaCO_3$

* substitute pH for hardness in the equations for pentachlorophenol

CF = Conversion Factor to calculate dissolved metal from total metal concentrations

- = no recommended value

@ = Cadmium Conversion Factors:
acute CF = 1.136672 - [(ln H) x 0.041838]
chronic CF = 1.101672 - [(ln H) x 0.041838]

= Lead Conversion Factors:
acute and chronic CF = 1.46203 - [(ln H) x 0.145712]

[ln H] = natural log of hardness

EXAMPLE:
If you wish to calculate the acute criteria for Copper at a hardness of 30 mg/l, the equation value for m_a = 0.9422, b_a = -1.464, and CF = 0.96 from Table 2. The acute criteria equation for dissolved Copper is therefore:

$$0.96 \times e^{(0.9422[\ln 30] + (-1.464))} = 5.47$$

Result : The acute criteria for Dissolved Copper at a hardness of 30 mg/l is = 5.47 μg/l

Table 3 Ammonia Criteria

A. Freshwater:

1. Acute Criteria as Total Ammonia (mg/l)

pH	Temperature (C)						
	0	5	10	15	20	25	30
6.50	35	33	31	30	29	29	29
6.75	32	30	28	27	27	26	26
7.00	28	26	25	24	23	23	23
7.25	23	22	20	19.7	19.2	19	19
7.50	17.4	16.3	15.5	14.9	14.6	14.5	14.5
7.75	12.2	11.4	10.9	10.5	10.3	10.2	10.3
8.00	8.00	7.5	7.1	6.9	6.8	6.8	7.0
8.25	4.50	4.2	4.1	4.0	3.9	4.0	4.1
8.50	2.60	2.4	2.3	2.3	2.3	2.4	2.6
8.75	1.47	1.40	1.37	1.38	1.42	1.52	1.65
9.00	0.86	0.83	0.83	0.86	0.91	1.01	1.16

2. Chronic Criteria as Total Ammonia (mg/l)

pH	Temperature (C)						
	0	5	10	15	20	25	30
6.50	3.00	2.80	2.70	2.50	2.5	2.5	2.4
6.75	3.00	2.80	2.70	2.60	2.5	2.5	2.5
7.00	3.00	2.80	2.70	2.60	2.5	2.5	2.5
7.25	3.00	2.80	2.70	2.60	2.5	2.5	2.5
7.50	3.00	2.80	2.70	2.60	2.5	2.5	2.5
7.75	2.80	2.60	2.50	2.40	2.3	2.3	2.4
8.00	1.82	1.70	1.62	1.57	1.55	1.55	1.59
8.25	1.03	0.97	0.93	0.90	0.90	0.91	0.94
8.50	0.58	0.55	0.53	0.53	0.53	0.55	0.58
8.75	0.34	0.32	0.31	0.31	0.32	0.35	0.38
9.00	0.195	0.189	0.189	0.195	0.21	0.23	0.27

* To convert these values to mg/liter N, multiply by 0.822.

Table 3 continued

B. Saltwater: criteria as total ammonia (mg/l)

1. Acute Water Quality Criteria for Saltwater Aquatic Life Based on Total Ammonia (mg/l). (To convert these values to mg/liter N, multiply by 0.822).

	Temperature (C)							
	0	5	10	15	20	25	30	35
pH	Salinity = 10 g/kg							
7.0	270	191	131	92	62	44	29	21
7.2	175	121	83	58	40	27	19	13
7.4	110	77	52	35	25	17	12	8.3
7.6	69	48	33	23	16	11	7.7	5.6
7.8	44	31	21	15	10	7.1	5.0	3.5
8.0	27	19	13	9.4	6.4	4.6	3.1	2.3
8.2	18	12	8.5	5.8	4.2	2.9	2.1	1.5
8.4	11	7.9	5.4	3.7	2.7	1.9	1.4	1.0
8.6	7.3	5.0	3.5	2.5	1.8	1.3	0.98	0.75
8.8	4.6	3.3	2.3	1.7	1.2	0.92	0.71	0.56
9.0	2.9	2.1	1.5	1.1	0.85	0.67	0.52	0.44
	Salinity = 20 g/kg							
7.0	291	200	137	96	64	44	31	21
7.2	183	125	87	60	42	29	20	14
7.4	116	79	54	37	27	18	12	8.7
7.6	73	50	35	23	17	11	7.9	5.6
7.8	46	31	23	15	11	7.5	5.2	3.5
8.0	29	20	14	9.8	6.7	4.8	3.3	2.3
8.2	19	13	8.9	6.2	4.4	3.1	2.1	1.6
8.4	12	8.1	5.6	4.0	2.9	2.0	1.5	1.1
8.6	7.5	5.2	3.7	2.7	1.9	1.4	1.0	0.77
8.8	4.8	3.3	2.5	1.7	1.3	0.94	0.73	0.56
9.0	3.1	2.3	1.6	1.2	0.87	0.69	0.54	0.44
	Salinity = 30 g/kg							
7.0	312	208	148	102	71	48	33	23
7.2	196	135	94	64	44	31	21	15
7.4	125	85	58	40	27	19	13	9.4
7.6	79	54	37	25	21	12	8.5	6.0
7.8	50	33	23	16	11	7.9	5.4	3.7
8.0	31	21	15	10	7.3	5.0	3.5	2.5
8.2	20	14	9.6	6.7	4.6	3.3	2.3	1.7
8.4	12.7	8.7	6.0	4.2	2.9	2.1	1.6	1.1
8.6	8.1	5.6	4.0	2.7	2.0	1.4	1.1	0.81
8.8	5.2	3.5	2.5	1.8	1.3	1.0	0.75	0.58
9.0	3.3	2.3	1.7	1.2	0.94	0.71	0.56	0.46

Table 3 continued

B. Saltwater:

2. Chronic Water Quality Criteria for Saltwater Aquatic Life Based on Total Ammonia (mg/l). (To convert these values to mg/liter N, multiply by 0.822).

Temperature (C)

	0	5	10	15	20	25	30	35
pH	**Salinity = 10 g/kg**							
7.0	41	29	20	14	9.4	6.6	4.4	3.1
7.2	26	18	12	8.7	5.9	4.1	2.8	2.0
7.4	17	12	7.8	5.3	3.7	2.6	1.8	1.2
7.6	10	7.2	5.0	3.4	2.4	1.7	1.2	0.84
7.8	6.6	4.7	3.1	2.2	1.5	1.1	0.75	0.53
8.0	4.1	2.9	2.0	1.40	0.97	0.69	0.47	0.34
8.2	2.7	1.8	1.3	0.87	0.62	0.44	0.31	0.23
8.4	1.7	1.2	0.81	0.56	0.41	0.29	0.21	0.16
8.6	1.1	0.75	0.53	0.37	0.27	0.20	0.15	0.11
8.8	0.69	0.50	0.34	0.25	0.18	0.14	0.11	0.08
9.0	0.44	0.31	0.23	0.17	0.13	0.10	0.08	0.07
	Salinity = 20 g/kg							
7.0	44	30	21	14	9.7	6.6	4.7	3.1
7.2	27	19	13	9.0	6.2	4.4	3.0	2.1
7.4	18	12	8.1	5.6	4.1	2.7	1.9	1.3
7.6	11	7.5	5.3	3.4	2.5	1.7	1.2	0.84
7.8	6.9	4.7	3.4	2.3	1.6	1.1	0.78	0.53
8.0	4.4	3.0	2.1	1.5	1.0	0.72	0.50	0.34
8.2	2.8	1.9	1.3	0.94	0.66	0.47	0.31	0.24
8.4	1.8	1.2	0.84	0.59	0.44	0.30	0.22	0.16
8.6	1.1	0.78	0.56	0.41	0.28	0.20	0.15	0.12
8.8	0.72	0.50	0.37	0.26	0.19	0.14	0.11	0.08
9.0	0.47	0.34	0.24	0.18	0.13	0.10	0.08	0.07
	Salinity = 30 g/kg							
7.0	47	31	22	15	11	7.2	5.0	3.4
7.2	29	20	14	9.7	6.6	4.7	3.1	2.2
7.4	19	13	8.7	5.9	4.1	2.9	2.0	1.4
7.6	12	8.1	5.6	3.7	3.1	1.8	1.3	0.90
7.8	7.5	5.0	3.4	2.4	1.7	1.2	0.81	0.56
8.0	4.7	3.1	2.2	1.6	1.1	0.75	0.53	0.37
8.2	3.0	2.1	1.4	1.0	0.69	0.50	0.34	0.25
8.4	1.9	1.3	0.90	0.62	0.44	0.31	0.23	0.17
8.6	1.2	0.84	0.59	0.41	0.30	0.22	0.16	0.12

8.8	0.78	0.53	0.37	0.27	0.20	0.15	0.11	0.09
9.0	0.50	0.34	0.26	0.19	0.14	0.11	0.08	0.07

Table 4. Freshwater Water Effect Ratios and Site Specific Criteria Equations

Parameter	**Acute** $WER \times e^{(m_a [\ln hardness] + b_a)}$			**Chronic** (Acute Site Specific x 2) ÷ National Acute:Chronic Ratio
	WER[@]	m_a =	b_a =	National Acute:Chronic Ratio
Cadmium	2.2	1.128	-3.828	--
Copper	4.77	0.9422	-1.464	2.823
Lead	0.19	1.273	-1.46	51.29
Silver	2.85	1.72	-6.52	--
Zinc	1.63	0.8473	0.8604	2.208

[@] WER = Water Effect Ratio

-- = no recommended value, use chronic value as calculated in Table 2.

NOTE: 1). Resulting acute and chronic site specific criteria are as total recoverable metals. The conversion factors noted in Tables 1 and 2 cannot be applied to site specific criteria.

2). These WERs and resulting site specific criteria apply only to the segments of the Pawtuxet River classified as B1 (see Appendix A).

Table 5. 126 Priority Pollutants

The following comprise the list of toxic pollutants designated pursuant to Section 307(a)(1) of the Act

1. acenaphthene
2. acrolein
3. acrylonitrile
4. benzene
5. benzidine
6. carbon tetrachloride (tetrachloromethane)

Chlorinated Benzenes

7. chlorobenzene
8. 1,2,4-trichlorobenzene
9. hexachlorobenzene

Chlorinated Ethanes

10. 1,2-dichloroethane
11. 1,1,1-trichloroethane
12. hexachloroethane
13. 1,1-dichloroethane
14. 1,1,2-trichloroethane
15. 1,1,2,2-tetrachloroethane
16. chloroethane

Chloroalkyl Ethers

17. bis(2-chloroethyl) ether
18. 2-chloroethyl vinyl ether

Chlorinated Napthalene

19. 2-chloronapthalene

Chlorinated Phenols

20. 2,4,6-trichlorophenol
21. 4-chloro-3-methylphenol
22. chloroform (trichloromethane)
23. 2-chlorophenol

Dichlorobenzenes

24. 1,2-dichlorobenzene
25. 1,3-dichlorobenzene
26. 1,4-dichlorobenzene

Dichlorobenzidine

27. 3,3-dichlorobenzidine

Dichloroethylenes

28. 1,1-dichloroethylene
29. 1,2-trans-dichloroethylene

Table 5. 126 Priority Pollutants, cont.

30. 2,4-dichlorophenol

Dichloropropane and Dichloropropene

31. 1,2-dichloropropane
32. 1,3-dichloropropene (cis and trans isomers)

33. 2,4-dimethylphenol

Dinitrotoluene

34. 2,4-dinitrotoluene
35. 2,6-dinitrotoluene

36. 1,2-diphenylhydrazine
37. ethylbenzene
38. fluoranthene

Haloethers

39. 4-chlorophenyl phenyl ether
40. 4-bromophenyl phenyl ether
41. bis(2-chloroisopropyl) ether
42. bis(2-chlorethoxy) methane

Halomethanes

43. methylene chloride (dichloromethane)
44. methyl chloride (chloromethane)
45. methyl bromide (bromomethane)
46. bromoform (tribromomethane)
47. dichlorobromomethane
48. chlorodibromomethane

49. hexachlorobutadiene
50. hexachlorocyclopentadiene
51. isophorone
52. naphthalene
53. nitrobenzene

Nitrophenols

54. 2-nitrophenol
55. 4-nitrophenol
56. 2,4-dinitrophenol

57. 4,6-dinitro-2-methylphenol

Table 5. 126 Priority Pollutants, cont.

Nitrosamines

58. N-nitrosodimethylamine
59. N-nitrosodiphenylamine
60. N-nitrosodi-n-propylamine

61. pentachlorophenol
62. phenol

Phthalate Esters

63. bis-(2-ethylhexyl) phthalate
64. butyl benzyl phthalate
65. di-n-butyl phthalate
66. di-n-octyl phthalate
67. diethly phthalate
68. dimethyl phthalate

Polynuclear Aromatic Hydrocarbons

69. benzo(a)anthracene (1,2-benzanthracene)
70. benzo(a)pyrene (3,4-benzopyrene)
71. 3,4-benzofluoranthene
72. benzo(k)fluorathene (11,12-benzofluoranthene)
73. chrysene
74. acenaphthylene
75. anthracene
76. benzo(ghi)perylene (1,12-benzoperylene)
77. fluorene
78. phenanthrene
79. dibenzo(ah)anthracene (1,2,5,6-dibenzanthracene)
80. indeno (1,2,3-cd) pyrene (2,3-o-phenylenepyrene)
81. pyrene

82. tetrachloroethylene
83. toluene
84. trichloroethylene
85. vinyl chloride (chloroethylene)

Pesticides and Metabolites

86. aldrin
87. dieldrin
88. chlordane (technical mixture and metabolites)

DDT and Metabolites

89. 4,4' -DDT
90. 4,4' -DDE (p.p' -DDE)
91. 4,4' -DDD (p.p' -TDE)

Table 5. 126 Priority Pollutants, cont.

Endosulfan and Metabolites

92. a-endosulfan-Alpha
93. b-endosulfan-Beta
94. endosulfan sulfate

Endrin and Metabolites

95. endrin
96. endrin aldehyde

Heptachlor and Metabolites

97. heptachlor
98. heptachlor epoxide

Hexachlorocyclohexane

99. a-BHC-Alpha
100. b-BHC-Beta
101. g-BHC (lindane) Gamma
102. d-BHC-Delta

Polychlorinated Biphenyls (PCBs)

103. PCB-1242 (Arochlor 1242)
104. PCB-1254 (Arochlor 1254)
105. PCB-1221 (Arochlor 1221)
106. PCB-1232 (Arochlor 1232)
107. PCB-1248 (Arochlor 1248)
108. PCB-1260 (Arochlor 1260)
109. PCB-1016 (Arochlor 1016)
110. toxaphene

Metals, Asbestos and Cyanide

111. antimony and compounds
112. arsenic and compounds
113. asbestos
114. beryllium and compounds
115. cadmium and compounds
116. chromium and compounds
117. copper and compounds
118. cyanides
119. lead and compounds
120. mercury and compounds
121. nickel and compounds
122. selenium and compounds
123. silver and compounds
124. thallium and compounds
125. zinc and compounds
126. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)